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Epitome

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(57) [Abstract]
[Technical problem] The description of the refrigerant compound lubricating oil in sliding section every place of a compressor is detected, and the frozen air-conditioning compressor which carries out an operation control so that a compressor may be protected according to the defect of a lubricating oil is realized.
[Means for Solution] The fixed scrolling 4, the revolution scrolling 5, and the compressor style 2 that has Oldham ring 10 grade, In the frozen air-conditioning compressor which supplies refrigerant compound lubricating oil to the bearing 21 grade which is equipped with the motor 3 which has the revolving shaft 9 which carries out eccentric revolution of the revolution scrolling 5, and supports the sliding section and the revolving shaft 9 of scrolling 4, and the between five and the Oldham ring 10 The rate of attenuation of ultrasonic wave which computed and computed the rate of attenuation of ultrasonic wave from the output of a measurement means to measure the ultrasonic reinforcement which arranged the ultrasonic probe 19 (a, e, d, g) on each lubrication part, and each ultrasonic probe transmitted and received, From the relation between the ultrasonic propagation distance in the lubricating oil for which it asked beforehand, the cellular content of a lubricating oil, and the rate of attenuation of ultrasonic wave, an operation means to ask for cellular content, and the control means controlled so that this cellular content lowers motor 3 rotational frequency above a predetermined value are established.

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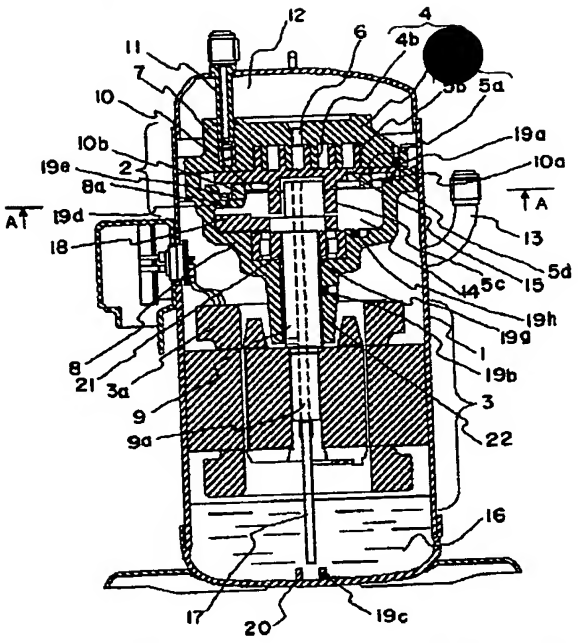

2：圧縮機構
3：電動機
4：固定スクロール
5：旋回スクロール
10：オルダムリング
16：潤滑油溜め
19a～19b：超音波プローブ
21：ころがり軸受

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CLAIMS

[Claim(s)]
[Claim 1] The frozen air-conditioning compressor which supplies refrigerant compound lubricating oil to lubrication parts, such as bearing which supports the sliding section and said revolving shaft of the moving-part material which is characterized by providing the following, and which is equipped with the motor which drives a compressor style and this compressor style through a revolving shaft in a well-closed container, and constitutes said compressor style Each ultrasonic probe received after it sends a supersonic wave periodically in each lubrication part thru/or the neighborhood of it and only predetermined distance spreads the inside of a lubricating oil A measurement means to measure the reinforcement of the supersonic wave which each ultrasonic probe sent, and the received reinforcement of a supersonic wave The rate of attenuation of ultrasonic wave which computed and this computed the rate of attenuation of ultrasonic wave of the receiving reinforcement to dispatch reinforcement from the dispatch reinforcement and receiving reinforcement of the measured this supersonic wave The control means controlled to stop or it lowers the rotational frequency of said motor, when the cellular content for which an operation means to ask for the cellular content of the lubricating oil of each lubrication part, and said operation means asked is larger than a predetermined value in either of each lubrication part from the relation between the ultrasonic propagation distance in the lubricating oil for which it asked beforehand, the cellular content of a lubricating oil, and the rate of attenuation of ultrasonic wave
[Claim 2] The frozen air-conditioning compressor which supplies refrigerant compound lubricating oil to

lubrication parts, such as bearing which supports the sliding section and said revolving shaft of the moving-part material which is characteri[illegible]by providing the following, and which i[illegible]uipped with the motor which drives a compressor style and this compressor style through a revolving shaft in a well-closed container, and constitutes said compressor style Each ultrasonic probe received after it sends a supersonic wave periodically in said each of lubrication part thru/or the neighborhood of it and only predetermined distance spreads the inside of a lubricating oil A measurement means to measure the duration from dispatch of each ultrasonic probe to reception The measured this duration The control means controlled to stop or it lowers the rotational frequency of said motor, when the lubricating oil viscosity for which an operation means to ask for the lubricating oil viscosity of each lubrication part, and said operation means asked is lower than a predetermined value from the relation between the ultrasonic propagation distance in the lubricating oil for which it asked beforehand, a propagation duration, and lubricating oil viscosity

[Claim 3] The Oldham ring which has the key key-seat sliding device which carries out a straight-line motion to revolution scrolling which carries out eccentric revolution to fixed scrolling and this fixed scrolling which are characterized by providing the following for rotation prevention of said revolution scrolling at the time of this eccentric revolution, and said fixed scrolling, The compressor style which consists of frames which hold said revolution scrolling and said Oldham ring in a predetermined location, It has the motor which has the revolving shaft which carries out eccentric revolution of said revolution scrolling into a well-closed container. The frozen air-conditioning compressor which supplies refrigerant compound lubricating oil to lubrication parts, such as bearing to which said fixed scrolling inferior surface of tongue and top face of said revolution scrolling are installed in the sliding section which slides mutually, the key key-seat sliding section of said Oldham ring, and said frame, and support said revolving shaft Each ultrasonic probe received after it sends a supersonic wave periodically in each lubrication part thru/or the neighborhood of it and only predetermined distance spreads the inside of a lubricating oil A measurement means to measure the reinforcement of the supersonic wave which each ultrasonic probe sent, and the received reinforcement of a supersonic wave The rate of attenuation of ultrasonic wave which computed and this computed the rate of attenuation of ultrasonic wave of the receiving reinforcement to dispatch reinforcement from the dispatch reinforcement and receiving reinforcement of the measured this supersonic wave The control means controlled to stop or the cellular content for which an operation means to ask for the cellular content of the lubricating oil of each lubrication part, and said operation means asked lowers the rotational frequency of said motor in either of each lubrication part at the time beyond a predetermined value from the relation between the ultrasonic propagation distance in the lubricating oil for which it asked beforehand, the cellular content of a lubricating oil, and the rate of attenuation of ultrasonic wave

[Claim 4] The supersonic wave which embedded the ultrasonic probe installed in the lubrication part which is said sliding section at the quiescence flank material which is the other party of the movable side member of the sliding section, and was sent from the ultrasonic probe is a frozen air-conditioning compressor according to claim 1, 2, or 3 characterized by having arranged so that it may reflect and may return from said movable side member through a lubricating oil.

[Claim 5] The frozen air-conditioning compressor which is equipped with the compressor style which has the eccentric shank which is characterized by providing the following, and which was contained in the cylinder and this cylinder, and each plain bearing installed in said cylinder both ends, and the motor which has the revolving shaft which connects with said eccentric shank and is supported by said plain bearing, and supplies refrigerant compound lubricating oil to said plain bearing The ultrasonic probe embedded at the sliding surface of each plain bearing A measurement means to measure the dispatch reinforcement and receiving reinforcement of a supersonic wave which are sent from this each ultrasonic probe, reflect from said revolving-shaft front face, and return through refrigerant compound lubricating oil The rate of attenuation of ultrasonic wave which computed and this computed the rate of attenuation of ultrasonic wave of the receiving reinforcement to dispatch reinforcement from the dispatch reinforcement and receiving reinforcement of the measured this supersonic wave The control means controlled to stop or it lowers the rotational frequency of said motor, when the cellular content for which an operation means to ask for the cellular content of the lubricating oil in the location of each ultrasonic probe, and said operation means asked is beyond a predetermined value from the relation between the ultrasonic propagation distance in the lubricating oil for which it asked beforehand, the cellular content of a lubricating oil, and the rate of attenuation of ultrasonic wave

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the positive-displacement-design refrigeration air-conditioning compressor used for a refrigerator, an air conditioner, etc., especially detects the condition of the lubricating oil in a compressor locally, and relates to the positive-displacement-design refrigeration air-conditioning compressor controlled to protect a compressor at the time of the defect of a lubricating oil.

[0002]

[Description of the Prior Art] In the frozen air-conditioning compressor, the lubricating oil is usually used in printing of the sliding section for prevention or wear reduction. However, if it was in such a frozen air-conditioning compressor, there were the following problems. Since the amount of the refrigerant which melts into a lubricating oil changes on the occasion of the pressure variation and the temperature change inside casing, the viscosity of a lubricating oil changes a lot, and also when the refrigerant which melted superfluously into the lubricating oil breaks away out of a lubricating oil, air bubbles are generated in an oil. Generally, the lubricating oil containing these air bubbles was lacking in lubricity, consequently had a fear of producing poor lubrication in the sliding section. When such poor lubrication occurred, wear took place to the sliding section and it led to increase of degradation and the noise, the fall of dependability, etc. Furthermore, there was a fear of a sliding part burning and breaking down. Then, if the amount of air bubbles mixed in the lubricating oil can be grasped during compressor operation, before the lubrication capacity of a lubricating oil is spoiled, operation of a frozen air-conditioning compressor can change the rotational speed of a stop or a shaft, and a poor lubrication condition can be avoided. Moreover, in the view of reliability evaluation, the unusual lubrication condition which has anxiety of failure, without waiting for failure by the prolonged test of a compressor can be discovered.

[0003] A means to detect like a publication as a means to detect generating of the poor lubrication in the sliding section, using an acoustic emission (AE) signal to JP,8-151992,A, and a means to detect using an energization signal like a publication to JP,10-288182,A are known. Since it generated only after a sliding surface and a sliding surface contact, these AE signals and energization signals were difficult to predict generating of wear beforehand.

[0004] Moreover, as an example which performs measurement in a compressor using a supersonic wave, the equipment which measures the amount of refrigerant mixing from the outside of a compressor to a lubricating oil [in a compressor / a sump] is in a JP,6-94687,A official report like a publication. However, in this equipment, since the sensibility of the ultrasonic signal measured varied with the quality of the material and surface roughness of a compressor container, it was very difficult that exact measurement is difficult and to detect penetration of the air bubbles to the inside of the lubricating oil in the sliding section, and to predict the poor lubrication of a compressor beforehand.

[0005]

[Problem(s) to be Solved by the Invention] It was difficult to avoid the fall of dependability, such as lack of lubrication resulting from generating of air bubbles, and an increment in wear by local poor lubrication, in a frozen air-conditioning compressor conventionally.

[0006] Moreover, it was difficult during operation to check a lubricating oil, and operation needed to be suspended periodically and check of a lubricating oil and the sliding section needed to be performed.

[0007] Then, this invention grasps the condition of the lubricating oil in the sliding section, with compression operation continued, and aims at implementation of the frozen air-conditioning compressor which added the equipment which controls operation of a compressor according to a poor lubricating oil.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the frozen air-conditioning compressor of this invention It has the motor which drives a compressor style and this compressor style through a revolving shaft in a well-closed container. In the frozen air-conditioning compressor which supplies

refrigerant compound lubricating oil to lubrication parts, such as bearing which supports the sliding section of the moving-part material which constitutes a compressor style, and the revolving shaft of a motor Each ultrasonic probe received after it sends a supersonic wave periodically in each lubrication part thru/or the neighborhood of it and only predetermined distance spreads the inside of a lubricating oil, A measurement means to measure the reinforcement of the supersonic wave which each ultrasonic probe sent, and the received reinforcement of a supersonic wave, The rate of attenuation of ultrasonic wave which computed and this computed the rate of attenuation of ultrasonic wave of the receiving reinforcement to dispatch reinforcement from the dispatch reinforcement and receiving reinforcement of the measured this supersonic wave, An operation means to ask for the cellular content of the lubricating oil of each lubrication part from the relation between the ultrasonic propagation distance in the lubricating oil for which it asked beforehand, the cellular content of a lubricating oil, and the rate of attenuation of ultrasonic wave, It is characterized by establishing the control means controlled to stop or it lowers the rotational frequency of a motor, when the cellular content for which the operation means asked is larger than a predetermined value in either of each lubrication part.

[0009] Moreover, a measurement means for another frozen air-conditioning compressor to install an ultrasonic probe like the above-mentioned frozen air-conditioning compressor, and to measure the duration from dispatch of each ultrasonic probe to reception, It is characterized by establishing the control means controlled to stop or it lowers the rotational frequency of a motor, when the measured this duration, the ultrasonic propagation distance in the lubricating oil for which it asked beforehand, and the lubricating oil viscosity for which the propagation duration aforementioned operation means asked are lower than a predetermined value.

[0010] in each above-mentioned frozen air-conditioning compressor , the amount of air bubbles which exist in the refrigerant oil which exist in the sliding section from the reinforcement of the supersonic wave which spread the inside of the lubricating oil which a refrigerant and air bubbles mixed , or relation with acoustic velocity , or the viscosity of a lubricating oil be compute , abnormal conditions , such as an unusual hypoviscosity condition or a plasmotomy condition of an oil film , be detect , a compressor be control , and a poor lubrication condition be avoid .

[0011] As the sliding section which is the lubrication part of a frozen air-conditioning compressor, the sliding section formed in a scrolling compressor of the key and the key seat in the Oldham ring have the key key-seat sliding device in_which a straight-line motion is carried out for the rotation prevention of revolution scrolling at the time of the sliding section formed of the top face of revolution scrolling which carries out eccentric revolution to the inferior surface of tongue of fixed scrolling and this fixed scrolling, or eccentric revolution is, for example. Moreover, in a rotary compressor, there is a plain bearing which supports the revolving shaft which it is prepared in the both-ends side of the cylinder which contains an eccentric shank, and is connected with the eccentric section by the plain bearing.

[0012] By the way, the supersonic wave which embedded the ultrasonic probe installed in the sliding section at the quiescence flank material which is the other party of the movable side member of the sliding section, and was sent from the ultrasonic probe is good to arrange so that it may reflect and may return from said movable side member through a lubricating oil.

[0013]

[Embodiment of the Invention] Hereafter, the frozen air-conditioning compressor of this invention is explained concretely, referring to drawing 10 from drawing 1 .

[0014] Drawing of longitudinal section of the scrolling compressor with which drawing 1 serves as the gestalt 1 of operation of this invention, and drawing 2 are those of the drawing 1 A-A sectional view. This scrolling compressor inhales and compresses the refrigerant gas after using for air-conditioning, and supplies it to air-conditioning as a refrigerant gas of elevated-temperature high pressure. This scrolling compressor is functionally divided roughly. The well-closed container 1 of a cylindrical shape, The compressor style 2 which generates the compressed air within a container 1, and the motor 3 which drives the compressor style 2, It consists of ultrasonic probes which are installed in every place of a lubricating oil circulation path from the lubricating oil reservoir 16 which stores the refrigerant compound lubricating oil supplied to each sliding surface formed between the components which constitute the compressor style 2, or a member, and the lubricating oil reservoir 16 to each sliding surface of the compressor style 2, and detect the description of a lubricating oil. The compressor style 2 was contained in the upper part, it contained the motor 3 to pars intermedia, and the well-closed container 1 has formed the lubricating oil reservoir 16 in the lower part.

[0015] The fixed scrolling 4 in which the compressor style 2 has an outline and curled form lap 4b, The revolution scrolling 5 which has lap 5b engaged with lap 4b of the fixed scrolling 4, and forms compression space between 4between both laps b, and 5b, It consists of frames 8 which hold to a position the Oldham ring 10 which assembles 4 and 5 for both so that it may be made to circle in the revolution scrolling 5, without

rotating to the fixed scrolling 4, and the fixed scrolling 4, the revolution scrolling 5 and the Oldham ring 10.
[0016] The element which constitutes the compressor style 2 in more detail is explained. The fixed scrolling 4 consists of lap 4b formed at the involute curve or the curve of approximation in this in the crevice formed in the lower part (tooth-back side) of end plate 4a and this end plate 4a. On the other hand, the revolution scrolling 5 is constituted so that it may circle making curled form lap 5b which gears with lap 4b of the fixed school 4 project from an end plate 5a top face, making boss 5c which has the hole which makes the eccentric shank at revolving-shaft 9 tip of a motor 3 insert in an end plate 5a inferior surface of tongue come to project, and sliding on the periphery on the top face of end plate 5a with the inferior surface of tongue of the fixed scrolling 4. A frame 8 is the container of **, fixes the fixed scrolling 4 to a top face with a bolt, contains the revolution scrolling 5 and the Oldham ring to a building envelope, supports the main shaft 9 linking directly to the revolving shaft of a motor 3 in the lower part, rolls, it installs a bearing 21, and is constituted [it narrows the bottom, and], and is being itself fixed in the container 1. The Oldham ring 10 prepares in the symmetry key-seat 8a formed in 5d of key seats and the frame 8 interior which were formed in the revolution scrolling 5, and two keys which fit in, respectively about the eccentric shaft of a revolving shaft 9, and it is constituted so that a key seat and a key may slide and a linear reciprocating motion may be performed, so that the revolution scrolling 5 which carries out eccentric movement to the fixed scrolling 4 may not be made to rotate.
[0017] The refrigerant gas compressed by the compressor style 2 is breathed out by the regurgitation room 12 of the upper part of a well-closed container 1 from the delivery 6 which was taken in from the inhalation opening 7 of the fixed scrolling 4 in a container 1 through the suction pipe 11 prepared in the container 2 from the refrigerating cycle system besides a well-closed container 2, and was compressed by the compression space formed between lap 4b of both scrolling 4 and 5, and 5b, and was formed in the core of end plate 4a of the fixed scrolling 4. The refrigerant gas of elevated-temperature high pressure breathed out by the regurgitation room 12 flows into the room of the bottom formed between the frame 8 and the well-closed container 1 through the path, and is supplied to a refrigerating cycle system through the discharge tube 13 formed in the outer wall of a well-closed container 1.
[0018] On the other hand, the middle pressure of suction pressure and a discharge pressure is acting on the space (back pressure room) 14 surrounded with the tooth back and frame 8 of the revolution scrolling 5. This intermediate pressure forms pore (back pressure hole) 15 in end plate 5a of the revolution scrolling 5, leads the gas in the middle of the compression inside scrolling to space (back pressure room) 14 through this pore 15, and makes gas act on the tooth back of the revolution scrolling 5. While forcing the revolution scrolling 5 on the fixed scrolling 4 and sealing each compression space by the gas from this tooth back, seal of the periphery end plate side of both the scrolling members 4 and 5 is also performed.
[0019] The refrigerant compound lubricating oil of eye 16 a sump of well-closed container 1 pars basilaris ossis occipitalis By the differential pressure of the discharge pressure besides a frame 8, and the pressure of the back pressure room 14 in a frame 8 Pass the oil supply hole which branches in the direction of a path of a revolving shaft 9 from oil supply hole 9a which penetrates the axial center of this revolving shaft 9, and oil supply hole 9a from the feed pipe 17 attached in the bottom of the revolving shaft 9 of a motor 3. It is supplied with oil to the sliding sections, such as the antifriction bearing 21 in a frame 8, a key key seat of the Oldham ring, and both scrolling 4 and 5. And the lubricating oil discharged from each sliding section is breathed out by the regurgitation room 12 from the delivery 6 established in end plate 4a of the fixed scrolling 4 through the compression space between the back pressure hole 15 prepared in end plate 5a of the revolution scrolling 5, both scrolling 4, and 5 from the back pressure room 14 of a frame 8. At this time, a lubricating oil is breathed out in connection with a refrigerant gas. These refrigerant gases and a lubricating oil accompany a well-closed container 1 with a path and a guide (not shown) from the regurgitation room 12, and flow toward the motor section 3, the lubricating oil separated by the coil of the motor section 3 upper part and 3a flows to downward eye 16 a sump, and on the other hand, a refrigerant gas accompanies container 1 wall, flows, and is sent out from a discharge tube 13 to a refrigerating cycle system.
[0020] The oil supply to the sliding section of the Oldham ring 10 passes oil supply hole 9a of a main shaft 9 from eye 16 a sump by the differential pressure of frame 8 inside and outside, uses it for the lubrication of a fixed pivot carrier, and is performed by covering the lubricating oil which fell to the balance weight 18 of a frame 8 in the back pressure room 14 of a frame 8, and a fluid oil film is formed in the sliding section of a key key seat.
[0021] As an ultrasonic probe 19 (an ultrasonic probe is named generically and agreement 19 is attached) which detects the description of refrigerant compound lubricating oil Support the revolving shaft of a motor 3, roll and ultrasonic probe 19g is arranged at the bearing 21 section. Ultrasonic probe 19b in the sliding section of the key key seat of the Oldham ring 10 in this about 21 bearing lubricating oil passage Ultrasonic probe 19d, 19e -- ultrasonic probe 19c is arranged [ultrasonic probe 19a] for ultrasonic probe 19h at the sliding section

of end plate 4b of the fixed scrolling 4, and end plate 5b of the revolution scrolling 5 in the lubricating oil reservoir 16 of container 1 pars [redacted]silaris ossis occipitalis at the pars bas[redacted] ossis occipitalis of the back pressure room 14 in a frame 8. [redacted]ddition, it arranges in the part of arbitration. The ultrasonic probe 19 measures the amount of the bubble in the lubricating oil in every place of the lubricating oil path in a scrolling compressor, or the viscosity of a lubricating oil. The ultrasonic probe 19 is attached using insulating adhesives, and the periphery is insulated.

[0022] When an ultrasonic probe is installed for the purpose of measurement of the lubricating oil by which it is placed between the sliding sections (for example, sliding section of the key of the Oldham ring 10, and the key seat of a frame 8), [whether as shown in drawing 3 , it measures by exposing the sensor side of an ultrasonic probe on the sliding surface by the side of key-seat 8a which stands it still, and] There is the approach of measuring through wall 8b between the front face of ultrasonic probe 19e and the front face of key section 10b of the Oldham ring, without exposing a sensor side, as shown in drawing 4 . When the former is performed, high sensibility is obtained compared with the case where the latter is performed. the location where the sensor side of an ultrasonic probe is equal to a sliding surface when measuring by exposing an ultrasonic probe front face on a sliding surface -- or it is more desirable than a sliding surface to install in the location investigated dozens of micrometers from several micrometers. Even when the liquid film between sliding surfaces is disrupted by choosing the installation location of the optimal ultrasonic probe, an ultrasonic probe is protected, and also it is influenced by unexpected contact of a sliding surface, and reliable measurement can be realized rather than there is nothing. Moreover, since the cause of poor lubrication can be specified from the part of the ultrasonic sensor 19 which detected contact between 2 members which slide mutually, a reliable compressor is realizable.

[0023] as [become / a sensor side is in the sliding surface of a key seat, and / embed ultrasonic probe 19e on one side face of key-seat 8a, and / as shown in drawing 2 and drawing 3 / when forming the ultrasonic probe 19 in the sliding section in a scrolling compressor / side / in the sliding section of the Oldham ring 10, / the sliding direction and a right angle] -- it installs and one sliding surface of key 10b is used as a reflector. Also ultrasonic probe 19f installed in the side face of another side of key-seat 8a, it installs like ultrasonic probe 19e, and the sliding surface of another side of key 10b is used as a reflector. Moreover, ultrasonic probe 19d installed in the inferior surface of tongue of key-seat 8a, it is installed at right angles to the inferior surface of tongue of key 10b, and the base of key 10b is used as a reflector.

[0024] In the antifriction bearing 21 section which supports the rotation main shaft 9 of a motor 3, ultrasonic probe 19g is installed in the frame 8 side, and the end face of a thrust-bearing member is used as a reflector this probe 19g so that the end face of the thrust-bearing member of antifriction bearing 21 may be countered. Moreover, in order to check the lubricating oil of a lubricating oil path which results in antifriction bearing 21, i.e., the lubricating oil which flows in the clearance between the rotation main shaft 9 of a motor 3, and the hole established in the frame 8 which inserts it in, ultrasonic probe 19b is installed in the front face of the rotation main shaft 9 in the perpendicular direction at a frame 8 side, and this ultrasonic probe 19b uses main shaft 9 front face as a reflector. These supersonic-waves probes 19b and 19g detect the poor lubrication generated from penetration of the air bubbles to the lubricating oil liquid film in the sliding section of bearing 21, or the lack of oil quantity in the sliding section.

[0025] When attaching the ultrasonic probe 19 in the location covered with the lubricating oil reservoir 16 or a lubricating oil As shown in drawing 5 , two ultrasonic probes 19i and 19j are opposed in fixed distance on a straight line. As appoint one side as an origination-side supersonic-wave probe, and another side is appointed at a receiving-side supersonic-wave probe, it installs so that the lubricating oil for measurement may flow between these two probes, or shown in drawing 6 One ultrasonic probe 19c and a reflector 20 are made to counter fixed distance on a straight line similarly, it installs, and between these ultrasonic probe 19c and reflectors 20 is made for the lubricating oil for measurement to flow. The reflector which counters ultrasonic probe 19h and it is established in the back pressure room 14 of a frame 8 as well as the inside of the lubricating oil reservoir 16. Measuring [and] the cellular condition and viscosity in the lubricating oil in the back pressure room 14 ultrasonic probe 19h, ultrasonic probe 19c measures the condition of the lubricating oil in the sump ball 16. Since the amount of air bubbles and viscosity in a lubricating oil are measured to coincidence with one measurement means, it predicts in advance that a lubrication condition gets worse from increase of the amount of air bubbles in a lubricating oil, and the viscosity down of the degree of pole.

[0026] Next, drawing 7 explains the rotary compressor used as the gestalt of operation of the 2nd of the compressor for frozen air-conditioning of this invention. Functionally, this rotary compressor consists of a lubricating oil reservoir which stores the refrigerant compound lubricating oil supplied to the sliding surface of the compressor style which compresses a refrigerant gas within a vertical mold cylinder-like well-closed container and a well-closed container, the motor which drives a compressor style, the components which

constitute a compressor style, or a member, and an ultrasonic probe which detects the description of the lubricating oil in each sliding sur[illegible] Within the well-closed container, the [illegible]tor, the compressor style, and the lubricating oil reservoir are installed sequentially from the top.

[0027] The motor 47 has the rotation shaft 42 prolonged caudad. Eccentric shank 42a in which the compressor style was formed near the lower part point of the rotation rotation shaft 42, The cylinder 45 which contains the roller 46 with which eccentric rotation is given by eccentric shank 42a, and eccentric shank 42a and a roller 46, It consists of a main bearing member 41 (journal plain bearing) which supports the rotation shaft 42 when it comes to [both] the top cover of a cylinder 45, and countershaft receiving part material 44 (journal plain bearing) which supports the point of the rotation shaft 42 while becoming the lower lid of a cylinder 45. And the refrigerant compound lubricating oil of a lubricating oil reservoir is supplied to the bearing members 41 and 44 through the branching hole which branches in the direction of a path from the axial center hole formed in the axial center of the rotation shaft 42, to a lubricating oil, a fluid oil film is made and, as for the sliding section of each bearing member, smooth lubrication is secured.

[0028] As the ultrasonic probe 19 is shown in drawing 7 , ultrasonic probe 19k is installed in the location by the side of compression space 43 by the main bearing member 41, and it is the countershaft receiving part material 44, and ultrasonic probe 19l. is installed in the location by the side of compression space 43 close attendants at the lower limit side of the countershaft receiving part material 44, and ultrasonic probe 19m is further installed in ultrasonic probe 19n at the upper limit side of the main bearing member 41. These supersonic-waves probe measures the amount of air bubbles in the lubricating oil between the sliding surfaces of each bearing member and the rotation shaft 42 etc.

[0029] In addition, the ultrasonic probe which detects the description of a lubricating oil can also be applied to the reciprocating compressor other than a scrolling compressor and a rotary compressor.

[0030] Next, the control which protects the various above-mentioned compressors using relation and these relation, such as air bubbles in a lubricating oil, ultrasonic reinforcement, and acoustic velocity, is explained. The HFC system refrigerant was mixed, the supersonic wave with a frequency of 10MHz was discharged in the ether system lubricating oil to which air bubbles are intermingled, and it asked for the relation between the amount of air bubbles, and the reinforcement (receiving reinforcement) of the supersonic wave which spread the distance of 5mm in the oil. Consequently, the reinforcement of a supersonic wave becomes the inclination which decreases with increase of the amount of air bubbles, as shown in drawing 8 . Here, receiving reinforcement of the supersonic wave in a lubricating oil without air bubbles was set to 100. The attenuation factor of a supersonic wave ** and computes the value which subtracted the receiving reinforcement in the lubricating oil which air bubbles contain from the receiving reinforcement in a lubricating oil without air bubbles by the receiving reinforcement in a lubricating oil without air bubbles. Moreover, it asked for the relation between the viscosity of a lubricating oil, and the acoustic velocity of the supersonic wave in the oil in the same conditions. Consequently, the acoustic velocity of a supersonic wave becomes the inclination which increases with increase of the viscosity of the lubricating oil which the refrigerant mixed, as shown in drawing 9 . This inclination is not greatly influenced by change of temperature or a pressure. Although it is not illustrating when other frequencies are used from 10MHz, the property over the air bubbles in a lubricating oil changes with frequencies of the supersonic wave sent from an ultrasonic probe. If the supersonic wave of a RF 5MHz or more is used, even air bubbles with a small diameter can detect sensitively, and the reinforcement of a reflected wave will decrease greatly also to little air bubbles. Moreover, when the supersonic wave of the low frequency not more than hundreds of kHz thru/or it is used, the strength reduction of a reflected wave becomes small and it is suitable for measurement of the lubricating oil containing a lot of air bubbles.

[0031] An arithmetic sequence unit 30 consists of a measurement circuit 31, an arithmetic circuit 32, and a control means 33, as shown in drawing 10 . The measurement circuit 31 operates each ultrasonic probe 19 periodically, measures the reinforcement and reflex time to which the supersonic wave which the ultrasonic probe 19 discharged has reflected and returned from the output of the ultrasonic probe 19, and gives the value to an arithmetic circuit 32. An arithmetic circuit 32 about each ultrasonic probe installed in the compressor for frozen air-conditioning The relation and the attenuation factor of the reinforcement of the supersonic wave which spread the inside of the lubricating oil of refrigerant mixing as shown in drawing 8 according to the travelling distance of the supersonic wave, and the amount of air bubbles contained in a lubricating oil are memorized beforehand. He computes an attenuation factor from the reinforcement of the supersonic wave periodically given from each ultrasonic probe during compressor operation, and is trying to output the value corresponding to the amount of air bubbles in an oil (%) from this attenuation factor. Moreover, the arithmetic circuit 32 has memorized beforehand the relation of the acoustic velocity of a supersonic wave and the viscosity of a lubricating oil which spread the inside of the lubricating oil of refrigerant mixing as shown in drawing 9 , and he is trying to output the value of lubricating oil viscosity about each ultrasonic probe based on

the acoustic velocity of the supersonic wave periodically given from each ultrasonic probe during compressor operation similarly.
[0032] A control means 33 changes the operation frequency of a compressor based on the signal from an arithmetic circuit 32, and controls the motor section 3. Generally, since many poor lubrication occurs when a pressure load is excessive, it controls to lower a rotational frequency and to mitigate a load.
[0033] The correspondence which raises a compressor rotational frequency for the purpose of a refrigerating cycle having the detection device of a pressure load, gathering a sliding rate when it can be judged that the fault size of a pressure load did not cause a poor lubricating oil, and raising coat formation may be suitable. When the difference of the discharge pressure of a compressor and suction pressure is small, it may be judged to be the cause of poor lubrication that oil supply of an initial complement cannot be performed, a rotational frequency is raised in this case, and the difference of a pressure is enlarged. Moreover, operation of the compression device section 2 may be stopped temporarily, and it may carry out as [aim at / the dissolution of poor lubrication].
[0034] In addition, it is good to establish a display means to display the output signal from the input signal, the contents of an operation, and the arithmetic unit to an arithmetic unit, about each ultrasonic probe. An element called the local amount of air bubbles and the viscosity in the refrigerant compound lubricating oil in the sliding section under compressor operation can be judged continuously and quantitatively by this, and since grasp of the lubrication condition of each sliding section currently checked according to the wear condition produced by the continuous running test covering the former and a long time can be made easy, improvement in the dependability of a frozen air-conditioning compressor is realizable.
[0035]
[Effect of the Invention] According to this invention, the condition of the lubricating oil in the sliding section in a compressor can be quantitatively grasped with a parameter called the amount of air bubbles and viscosity in refrigerant compound lubricating oil, with operation continued, and the frozen air-conditioning compressor which can control operation to protect a compressor according to a poor lubricating oil can be realized.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing of longitudinal section of the scrolling compressor used as the gestalt 1 of operation of this invention.
[Drawing 2] It is the sectional view of the A-A line of drawing 1 .
[Drawing 3] It is the sectional view of the B-B line of drawing 2 .
[Drawing 4] It is the block diagram of the detecting element which does not expose an ultrasonic probe to a sliding surface.
[Drawing 5] It is the block diagram of a detecting element using a back pressure room and two ultrasonic probes [/ a sump].
[Drawing 6] It is the block diagram of a detecting element using a back pressure room, and one ultrasonic probe and reflector. [/ a sump]
[Drawing 7] It is the sectional view showing the rotary compressor used as the gestalt of operation of this invention.
[Drawing 8] It is the graph which shows the relation between the cellular content in the lubricating oil which a refrigerant blends, and the rate of attenuation of ultrasonic wave.
[Drawing 9] It is the graph which shows the relation between the viscosity of the lubricating oil which a

refrigerant blends, and the acoustic velocity of the supersonic wave in the oil.

[Drawing 10] It is drawing showing the configuration of the arithmetic sequence unit which processes the signal from the ultrasonic probe installed in the compressor.

[Description of Notations]

1 Well-closed Container
2 Compressor Style
3 Motor
4 Fixed Scrolling
5 Revolution Scrolling
8 Frame
8a Frame side key seat
8b Ultrasonic probe protection wall
9 Main Shaft
9a Oil supply hole
10 Oldham Ring
10b Oldham ring side key section
16 Lubricating Oil Reservoir
19a-19h Ultrasonic probe
20 Reflector
21 Thrust Bearing Member
22 Countershaft Receiving Part Material
30 Arithmetic Sequence Unit
31 Measurement Circuit
32 Arithmetic Circuit
33 Control Means
40 Well-closed Container
41 Main Bearing Member
42 Rotation Shaft
43 Compression Space
44 Countershaft Receiving Part Material
45 Cylinder
46 Roller
47 Motor

[Translation done.]

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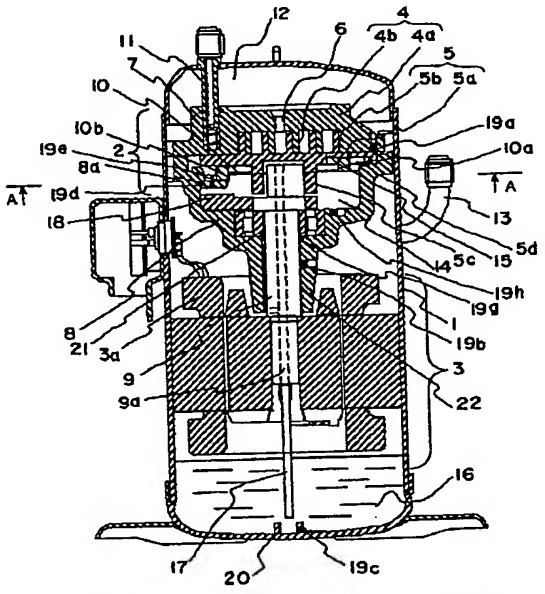
(54)【発明の名称】　冷凍空調圧縮機

(57)【要約】
【課題】　圧縮機の摺動部各所での冷媒混合潤滑油の性状を検出し、潤滑油の不良に応じて圧縮機を保護するよう運転制御する冷凍空調圧縮機を実現する。
【解決手段】　固定スクロール４、旋回スクロール５、オルダムリング１０等を有する圧縮機構２と、旋回スクロール５を偏心旋回させる回転軸９を有する電動機３を備え、スクロール４、５間やオルダムリング１０の摺動部及び回転軸９を支持する軸受２１等に冷媒混合潤滑油を供給する冷凍空調圧縮機において、各潤滑箇所に超音波プローブ19(a，e，d，g)を配し、各超音波プローブが送受信した超音波強度を計る計測手段の出力から超音波減衰率を算出し、算出した超音波減衰率と、予め求めた潤滑油中の超音波伝播距離と潤滑油の気泡含有率と超音波減衰率との関係とから、気泡含有率を求める演算手段と、該気泡含有率が所定値以上で電動機３回転数を下げるよう制御する制御手段とを設けたものである。



2：圧縮機構
3：電動機
4：固定スクロール
5：旋回スクロール
１０：オルダムリング
１６：潤滑油溜め
１９ａ～１９ｂ：超音波プローブ
２１：ころがり軸受

【特許請求の範囲】

【請求項１】　密閉容器内に圧縮機構及び該圧縮機構を回転軸を介して駆動する電動機を備え、前記圧縮機構を構成する可動部材の摺動部及び前記回転軸を支持する軸受部などの潤滑箇所に冷媒混合潤滑油を供給する冷凍空調圧縮機において、各潤滑箇所ないしその近辺で周期的に超音波を発信し潤滑油中を所定距離だけ伝播した後に受信する各超音波プローブと、各超音波プローブの発信した超音波の強度及び受信した超音波の強度を計測する計測手段と、該計測した超音波の発信強度と受信強度から発信強度に対する受信強度の超音波減衰率を算出し、該算出した超音波減衰率と、予め求めた潤滑油中の超音波伝播距離と潤滑油の気泡含有率と超音波減衰率との関係とから、各潤滑箇所の潤滑油の気泡含有率を求める演算手段と、前記演算手段が求めた気泡含有率が各潤滑箇所のいずれかで所定値より大きい時に前記電動機の回転数を下げるもしくは停止するように制御する制御手段とを設けたことを特徴とする冷凍空調圧縮機。

【請求項２】　密閉容器内に圧縮機構及び該圧縮機構を回転軸を介して駆動する電動機を備え、前記圧縮機構を構成する可動部材の摺動部及び前記回転軸を支持する軸受部などの潤滑箇所に冷媒混合潤滑油を供給する冷凍空調圧縮機において、前記潤滑箇所それぞれないしその近辺で周期的に超音波を発信し潤滑油中を所定距離だけ伝播した後に受信する各超音波プローブと、各超音波プローブの発信から受信までの所要時間を計測する計測手段と、該計測した所要時間と、予め求めた潤滑油中の超音波伝播距離と伝播所要時間と潤滑油粘度との関係から、各潤滑箇所の潤滑油粘度を求める演算手段と、前記演算手段が求めた潤滑油粘度が所定値より低いときに前記電動機の回転数を下げるもしくは停止するように制御する制御手段とを設けたことを特徴とする冷凍空調圧縮機。

【請求項３】　固定スクロールと該固定スクロールに対して偏心旋回する旋回スクロールと該偏心旋回時に前記旋回スクロールの自転防止のため直線動作するキー・キー溝摺動機構を有するオルダムリングと前記固定スクロール、前記旋回スクロール及び前記オルダムリングを所定位置に保持するフレームとから構成される圧縮機構と、前記旋回スクロールを偏心旋回させる回転軸を有する電動機とを密閉容器中に備え、前記固定スクロール下面と前記旋回スクロールの上面が互いに摺動する摺動部、前記オルダムリングのキー・キー溝摺動部及び前記フレーム内に設置され前記回転軸を支持する軸受部などの潤滑箇所に冷媒混合潤滑油を供給する冷凍空調圧縮機において、各潤滑箇所ないしその近辺で周期的に超音波を発信し潤滑油中を所定距離だけ伝播した後に受信する各超音波プローブと、各超音波プローブの発信した超音波の強度及び受信した超音波の強度を計測する計測手段と、該計測した超音波の発信強度と受信強度から発信強度に対する受信強度の超音波減衰率を算出し、該算出した超音波減衰率と、予め求めた潤滑油中の超音波伝播距離と潤滑油の気泡含有率と超音波減衰率との関係とから、各潤滑箇所の潤滑油の気泡含有率を求める演算手段と、前記演算手段が求めた気泡含有率が各潤滑箇所のいずれかで所定値以上の時に前記電動機の回転数を下げるもしくは停止するように制御する制御手段とを設けたことを特徴とする冷凍空調圧縮機。

【請求項４】　前記摺動部である潤滑箇所に設置された超音波プローブは摺動部の可動側部材の相手方である静止側部材に埋め込み、超音波プローブから発信した超音波は潤滑油を介して前記可動側部材から反射して戻るように配置したことを特徴とする請求項１、２又は３に記載の冷凍空調圧縮機。

【請求項５】　シリンダと該シリンダ内に収納された偏心軸部と前記シリンダ両端に設置された各すべり軸受とを有する圧縮機構と、前記偏心軸部に接続し前記すべり軸受に支持される回転軸を有する電動機とを備え、前記すべり軸受に冷媒混合潤滑油を供給する冷凍空調圧縮機において、各すべり軸受のすべり面に埋め込まれた超音波プローブと、該各超音波プローブから発信され前記回転軸表面から反射して冷媒混合潤滑油を介して戻る超音波の発信強度及び受信強度を計測する計測手段と、該計測した超音波の発信強度と受信強度から発信強度に対する受信強度の超音波減衰率を算出し、該算出した超音波減衰率と、予め求めた潤滑油中の超音波伝播距離と潤滑油の気泡含有率と超音波減衰率との関係とから、各超音波プローブの位置における潤滑油の気泡含有率を求める演算手段と、前記演算手段が求めた気泡含有率が所定値以上の時に前記電動機の回転数を下げるもしくは停止するように制御する制御手段とを設けたことを特徴とする冷凍空調圧縮機。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、冷蔵庫や空気調和機等に用いる容積型冷凍空調圧縮機に係り、特に圧縮機内の潤滑油の状態を局所的に検知して、潤滑油の不良時に圧縮機を保護するように制御する容積型冷凍空調圧縮機に関する。

【０００２】

【従来の技術】冷凍空調圧縮機では、通常、摺動部の焼き付きを防止あるいは摩耗低減のために潤滑油が用いられている。しかしながら、このような冷凍空調圧縮機にあっては次のような問題があった。ケーシング内部の圧力変化及び温度変化に際して、潤滑油に溶け込む冷媒の量が変化するため、潤滑油の粘度が大きく変化するほか、潤滑油中に過剰に溶け込んだ冷媒が潤滑油中から離脱するときに油中に気泡を発生する。この気泡を含む潤滑油は一般に潤滑性に乏しく、この結果、摺動部において潤滑不良を生じさせる危惧があった。このような潤滑不良が発生すると、摺動部に摩耗が起こり性能低下、騒

音の増大、信頼性の低下等につながった。さらには、摺動部分が焼き付いたりして故障する心配があった。そこで、圧縮機運転中に潤滑油に混入した気泡量を把握できれば、潤滑油の潤滑能力が損なわれる前に冷凍空調圧縮機の運転を止め、または軸の回転速度を変化させ、潤滑不良状態を回避することができる。また、信頼性評価の視点においては、圧縮機の長期試験による故障を待たずに故障の危惧のある異常な潤滑状態を発見できる。

【０００３】摺動部における潤滑不良の発生を検知する手段として、特開平８－１５１９９２号公報に記載のように、アコースティックエミッション(ＡＥ)信号を用いて検知する手段や、特開平１０－２８８１８２号公報に記載のように通電信号を用いて検知する手段が知られている。これらのＡＥ信号や通電信号は、摺動面と摺動面とが接触して初めて発生するために、摩耗の発生を未然に予測する事が困難であった。

【０００４】また、超音波を利用して圧縮機内の計測を行う例としては、特開平６－９４６８７公報に記載のように、圧縮機の外部から圧縮機内の油溜めにおける潤滑油への冷媒混入量を計測する装置がある。しかし、この装置においては、計測される超音波信号の感度が圧縮機容器の材質及び表面あらさによりばらつくため正確な計測が難しいこと、また、摺動部における潤滑油中への気泡の進入を検知し圧縮機の潤滑不良を未然に予測することは非常に困難であった。

【０００５】

【発明が解決しようとする課題】従来、冷凍空調圧縮機においては、気泡の発生に起因した潤滑不足や局所的な潤滑不良による摩耗の増加等の信頼性の低下を回避するのが困難であった。

【０００６】また、運転中に潤滑油の点検を行うことが困難であり、周期的に運転を停止して潤滑油、及び摺動部の点検を行なう必要があった。

【０００７】そこで、本発明は、圧縮運転を継続したままで摺動部における潤滑油の状態を把握して、潤滑油不良に応じて圧縮機の運転を制御する装置を付加した冷凍空調圧縮機の実現を目的としている。

【０００８】

【課題を解決するための手段】上記目的を達成するために、本発明の冷凍空調圧縮機は、密閉容器内に圧縮機構及び該圧縮機構を回転軸を介して駆動する電動機を備え、圧縮機構を構成する可動部材の摺動部及び電動機の回転軸を支持する軸受部などの潤滑箇所に冷媒混合潤滑油を供給する冷凍空調圧縮機において、各潤滑箇所ないしその近辺で周期的に超音波を発信し潤滑油中を所定距離だけ伝播した後に受信する各超音波プローブと、各超音波プローブの発信した超音波の強度及び受信した超音波の強度を計測する計測手段と、該計測した超音波の発信強度と受信強度から発信強度に対する受信強度の超音波減衰率を算出し、該算出した超音波減衰率と、予め求めた潤滑油中の超音波伝播距離と潤滑油の気泡含有率と超音波減衰率との関係とから、各潤滑箇所の潤滑油の気泡含有率を求める演算手段と、演算手段が求めた気泡含有率が各潤滑箇所のいずれかで所定値より大きい時に電動機の回転数を下げるもしくは停止するように制御する制御手段とを設けたことを特徴とする。

【０００９】また別の冷凍空調圧縮機は、上記の冷凍空調圧縮機と同様に超音波プローブを設置し、各超音波プローブの発信から受信までの所要時間を計測する計測手段と、該計測した所要時間と、予め求めた潤滑油中の超音波伝播距離と伝播所要時間前記演算手段が求めた潤滑油粘度が所定値より低いときに電動機の回転数を下げるもしくは停止するように制御する制御手段とを設けたことを特徴とする。

【００１０】上記各冷凍空調圧縮機においては、冷媒や気泡の混入した潤滑油中を伝播した超音波の強度あるいは音速との関係から摺動部に存在する冷媒油中に存在する気泡量あるいは潤滑油の粘度を算出し、異常な低粘度状態あるいは油膜の断裂状態といった異常状態を検出して、圧縮機を制御して潤滑不良状態を回避する。

【００１１】冷凍空調圧縮機の潤滑箇所である摺動部としては、例えば、スクロール圧縮機においては、固定スクロールの下面と該固定スクロールに対して偏心旋回する旋回スクロールの上面により形成される摺動部や偏心旋回時に旋回スクロールの自転防止のため直線動作するキー・キー溝摺動機構を有するオルダムリングにおけるキーとキー溝により形成される摺動部などがある。また、ロータリ圧縮機においては、偏心軸部を収納するシリンダの両端面に設けられすべり軸受で偏心部と接続する回転軸を支持するすべり軸受などがある。

【００１２】ところで、摺動部に設置された超音波プローブは、摺動部の可動側部材の相手方である静止側部材に埋め込み、超音波プローブから発信した超音波は潤滑油を介して前記可動側部材から反射して戻るように配置するのがよい。

【００１３】

【発明の実施の形態】以下、図１から図１０を参照しながら本発明の冷凍空調圧縮機を具体的に説明する。

【００１４】図１は本発明の実施の形態１となるスクロール圧縮機の縦断面図、図２は図１Ａ－Ａ断面図のである。このスクロール圧縮機は、空調に用いた後の冷媒ガスを吸入し、そして圧縮して高温高圧の冷媒ガスとして空調用に供給するものである。このスクロール圧縮機は、機能的に大別して、円筒形の密閉容器１と、容器１内で圧縮空気を生成する圧縮機構２と、圧縮機構２を駆動する電動機３と、圧縮機構２を構成する部品や部材間で形成される各摺動面に供給する冷媒混合潤滑油を貯える潤滑油溜め１６と、潤滑油溜め１６から圧縮機構２の各摺動面に至る潤滑油循環経路の各所に設置されて潤滑油の性状を検出する超音波プローブとから構成されてい

る。密閉容器１は、その上部に圧縮機構２を、中間部に電動機３を収納し、下部に潤滑油溜め１６を設けている。

【００１５】圧縮機構２は、概略、渦巻き状のラップ４ｂを有する固定スクロール４と、固定スクロール４のラップ４ｂと噛み合わせるラップ５ｂを有して両ラップ間４ｂ、５ｂ間に圧縮室を形成する旋回スクロール５と、旋回スクロール５を固定スクロール４に対して自転することなく旋回運動させるように両者を４、５を組み立てるオルダムリング１０と、固定スクロール４、旋回スクロール５、オルダムリング１０を所定の位置に保持するフレーム８とから構成されている。

【００１６】さらに詳しく圧縮機構２を構成する要素について説明する。固定スクロール４は、鏡板４ａと、該鏡板４ａの下部（背面側）に形成された凹部内にインボリュート曲線あるいはこれに近似の曲線に形成されたラップ４ｂとから構成されている。一方、旋回スクロール５は、固定スクール４のラップ４ｂと噛み合う渦巻き状のラップ５ｂを鏡板５ａ上面から突出させ、鏡板５ａ下面には電動機３の回転軸９先端の偏心軸部を挿入させる穴を有するボス５ｃを突出させてなり、鏡板５ａ上面の周部を固定スクロール４の下面と摺動しながら旋回するように構成されている。フレーム８は、下すぼまり状の容器であって、固定スクロール４を上面にボルトにより固定し、内部空間に旋回スクロール５及びオルダムリングを収納し、下部には電動機３の回転軸に直結する主軸９を支持するころがり軸受け２１を設置して構成され、かつ自らは容器１内に固定されている。オルダムリング１０は、固定スクロール４に対して偏心運動する旋回スクロール５を自転させないように、旋回スクロール５に形成されたキー溝５ｄおよびフレーム８内部に形成されたキー溝８ａとそれぞれ嵌合する２つのキーを回転軸９の偏心軸に関して対称に設け、キー溝とキーが摺動して直線的な往復運動を行うように構成されている。

【００１７】圧縮機構２により圧縮される冷媒ガスは、密閉容器２外の冷凍サイクル系から容器２に設けた吸入管１１を通じて容器１内の固定スクロール４の吸入口7から取り入れられ、両スクロール４、５のラップ４ｂ、５ｂ間に形成される圧縮室で圧縮され、そして固定スクロール４の鏡板４ａの中心に形成された吐出口６から密閉容器１の上部の吐出室１２に吐出される。吐出室１２に吐出された高温高圧の冷媒ガスは、通路を介してフレーム８と密閉容器1間に形成された下の部屋に流入し、そして密閉容器１の外壁に設けられた吐出管１３を通じて、冷凍サイクル系に供給される。

【００１８】他方、旋回スクロール５の背面とフレーム８でかこまれた空間（背圧室）１４には吸入圧力と吐出圧力の中間の圧力が作用している。この中間圧力は、旋回スクロール５の鏡板５ａに細孔（背圧孔）１５を設け、この細孔１５を介してスクロール内部の圧縮途中のガスを空間（背圧室）１４に導き、旋回スクロール５の背面にガスを作用させる。この背面からのガスにより、旋回スクロール５を固定スクロール４に押し付け、各圧縮室の密封を行うとともに両スクロール部材４、５の外周鏡板面の密封をも行う。

【００１９】密閉容器１底部の油溜め１６の冷媒混合潤滑油は、フレーム８外の吐出圧力とフレーム８内の背圧室１４の圧力の圧力差により、電動機３の回転軸９の下に取り付けられた給油管１７から、該回転軸９の軸心を貫通する給油孔９ａ及び給油孔９ａから回転軸９の径方向に分岐する給油孔を経て、フレーム８内のころがり軸受２１、オルダムリングのキー・キー溝、両スクロール４、５などの摺動部へ給油される。そして各摺動部より排出された潤滑油は、フレーム８の背圧室１４から旋回スクロール５の鏡板５ａに設けた背圧孔１５、両スクロール４、５間の圧縮室を経て固定スクロール４の鏡板４ａに設けた吐出口６から吐出室１２に吐出される。このとき、潤滑油は冷媒ガスに伴って吐出される。これら冷媒ガスと潤滑油は、吐出室１２から通路、ガイド（図示せず）により密閉容器１に添って電動機部３に向かって流れ、電動機部３上部のコイルエンド３ａで分離された潤滑油は下方の油溜め１６へ流れ、一方、冷媒ガスは容器１内壁に添って流れ吐出管１３より冷凍サイクル系へ送り出される。

【００２０】オルダムリング１０の摺動部への給油は、フレーム８内外の差圧により油溜め１６から主軸９の給油孔９ａを通過して旋回軸受の潤滑に利用し、フレーム８のバランスウェイト１８に落下した潤滑油がフレーム８の背圧室１４内にはねかけられることにより行われ、キー・キー溝の摺動部に流体油膜が形成される。

【００２１】冷媒混合潤滑油の性状を検出する超音波プローブ１９（超音波プローブを総称して符合１９を付す）として、電動機３の回転軸を支持するころがり軸受け２１部に超音波プローブ１９ｇが配置され、該軸受け２１近傍の潤滑油流路に超音波プローブ１９ｂが、オルダムリング１０のキー・キー溝の摺動部には超音波プローブ１９ｄ、１９ｅが、固定スクロール４の鏡板４ｂと旋回スクロール５の鏡板５ｂの摺動部に超音波プローブ１９ａが、フレーム８内の背圧室１４の底部に超音波プローブ１９ｈが、容器１底部の潤滑油溜め１６内に超音波プローブ１９ｃが配置されている。その他任意の箇所に配置する。超音波プローブ１９は、スクロール圧縮機内の潤滑油経路の各所における潤滑油中の泡の量あるいは潤滑油の粘度を計測する。超音波プローブ１９は絶縁性の接着剤を用いて取り付けられ、外周は絶縁されている。

【００２２】摺動部（例えばオルダムリング１０のキーとフレーム８のキー溝の摺動部）に介在する潤滑油の計測を目的に超音波プローブを設置する場合、図３に示すように超音波プローブのセンサ面を静止するキー溝８ａ

側の摺動面上に露出させて計測を行うか、図４に示すようにセンサ面を露出させずに超音波プローブ１９eの表面とオルダムリングのキー部１０ｂの表面との間に壁部８ｂを介して計測を行う方法がある。前者を実行した場合は後者を実行した場合に比べて高い感度が得られる。超音波プローブ表面を摺動面上に露出させて計測を行う場合には、超音波プローブのセンサ面は摺動面と等しい位置かあるいは摺動面より数マイクロメートルから数十マイクロメートル掘り下げた位置に設置することが望ましい。最適な超音波プローブの取り付け位置を選ぶことによって、摺動面間の流体膜がとぎれた場合でも超音波プローブが保護される他、摺動面の不慮の接触に影響されないより信頼性の高い計測が実現できる。また、互いに摺動する２部材間の接触を検出した超音波センサ１９の部位から潤滑不良の原因を特定出来るので、信頼性の高い圧縮機を実現できる。

【００２３】スクロール圧縮機内の摺動部に超音波プローブ１９を設ける場合、オルダムリング１０の摺動部では、図２及び図３に示すように、超音波プローブ１９ｅをキー溝８ａの一方の側面に埋め込み、センサ面がキー溝の摺動面にあって摺動方向と直角になるような設置し、キー１０ｂの一方の摺動面を反射面として用いる。キー溝８ａの他方の側面に設置する超音波プローブ１９ｆも超音波プローブ１９ｅと同様に設置し、キー１０ｂの他方の摺動面を反射面として用いる。またキー溝8aの下面に設置された超音波プローブ１９ｄはキー１０ｂの下面に垂直に設置され、キー１０ｂの底面を反射面として用いる。

【００２４】電動機３の回転主軸９を支持するころがり軸受２１部においては、ころがり軸受２１のスラスト軸受部材の端面に対向するように、フレーム８側に超音波プローブ１９ｇが設置されており、このプローブ１９ｇはスラスト軸受部材の端面を反射面として用いる。また、ころがり軸受２１に至る潤滑油経路の潤滑油、すなわち電動機３の回転主軸９とそれを挿通するフレーム８に設けた穴との間の隙間に流れる潤滑油をチェックするために、超音波プローブ１９ｂがフレーム８側に回転主軸９の表面に垂直な方向に設置され、この超音波プローブ１９ｂは主軸９表面を反射面として用いる。これら超音波プローブ１９ｂ、１９ｇは、軸受２１の摺動部における潤滑油流体膜への気泡の進入、あるいは摺動部における油量不足から発生する潤滑不良を検知する。

【００２５】潤滑油溜め１６あるいは潤滑油の溜まる場所に超音波プローブ１９を取り付ける場合は、図５に示すように、２つの超音波プローブ１９ｉ、１９ｊを一定距離に直線上に対抗させて、一方を発信側超音波プローブ、他方を受信側超音波プローブと定め、これら２つのプローブの間に計測対象の潤滑油が流れるように設置するか、あるいは図６に示すように、一つの超音波プローブ１９ｃと反射面２０を同様に一定距離に直線上に対向させて設置し、これらの超音波プローブ１９ｃと反射面２０との間を計測対象の潤滑油が流れるようにする。潤滑油溜め１６内と同様に、フレーム８の背圧室１４内にも、超音波プローブ１９ｈとそれに対向する反射面を設けている。超音波プローブ１９ｈは、背圧室１４内の潤滑油中の気泡状態と粘度を計測し、そして超音波プローブ１９ｃは油溜まり１６内の潤滑油の状態を計測する。潤滑油中の気泡量や粘度を一つの計測手段で同時に計測することから、潤滑油中の気泡量の増大及び極度の粘度低下から潤滑状態が悪化するのを事前に予測する。

【００２６】次に図７により、本発明の冷凍空調用圧縮機の第２の実施の形態となるロータリー圧縮機を説明する。このロータリー圧縮機は、機能的には、縦型円筒状の密閉容器と、密閉容器内で冷媒ガスを圧縮する圧縮機構と、圧縮機構を駆動する電動機と、圧縮機構を構成する部品や部材の摺動面に供給する冷媒混合潤滑油を蓄える潤滑油溜めと、各摺動面における潤滑油の性状を検出する超音波プローブとから構成されている。密閉容器内では、上から順に電動機、圧縮機構、潤滑油溜めが設置されている。

【００２７】電動機４７は下方に延びる回転シャフト４２を有している。圧縮機構は回転回転シャフト４２の下方先端部近くに形成された偏心軸部４２ａと、偏心軸部４２ａにより偏心回転が与えられるローラ４６と、偏心軸部４２ａ及びローラ４６を収納するシリンダ４５と、シリンダ４５の上蓋となると共に回転シャフト４２を支持する主軸受部材４１（ジャーナルすべり軸受）と、シリンダ４５の下蓋となると共に回転シャフト４２の先端部を支持する副軸受部材４４（ジャーナルすべり軸受）とから構成されている。そして潤滑油溜めの冷媒混合潤滑油は回転シャフト４２の軸心に形成された軸心孔から径方向に分岐する分岐孔を通じて軸受部材４１、４４に供給され、各軸受部材の摺動部は潤滑油によって流体油膜が作られ、円滑な潤滑が確保される。

【００２８】超音波プローブ１９は、図７に示す如く、主軸受部材４１で圧縮室４３側の位置に超音波プローブ１９ｋが設置され、また副軸受部材４４で圧縮室４３側近傍の位置に超音波プローブ１９ｌが、副軸受部材４４の下端側に超音波プローブ１９ｍが、さらに主軸受部材４１の上端側に超音波プローブ１９ｎに設置されている。これら超音波プローブは、各軸受部材と回転シャフト４２との摺動面間における潤滑油中の気泡量等を計測する。

【００２９】なお、潤滑油の性状を検出する超音波プローブは、スクロール圧縮機、ロータリー圧縮機のほかに、レシプロ圧縮機に適用することも可能である。

【００３０】次に潤滑油内の気泡と超音波強度、音速等の関係及び該関係を利用して上記の各種圧縮機を保護する制御について説明する。ＨＦＣ系冷媒が混合し、気泡の混在するエーテル系潤滑油中に周波数１０ＭＨｚの超

音波を発射して、気泡量と、その油中において５ｍｍの距離を伝播した超音波の強度（受信強度）との関係を求めた。その結果、超音波の強度は、図８に示すように、気泡量の増大とともに減少する傾向になる。ここで、気泡のない潤滑油における超音波の受信強度を１００とした。超音波の減衰率は、気泡のない潤滑油における受信強度から気泡の含む潤滑油における受信強度を減じた値を、気泡のない潤滑油における受信強度で除して算出する。また、同じ条件において、潤滑油の粘度とその油中の超音波の音速との関係を求めた。その結果、超音波の音速は、図９に示すように、冷媒の混合した潤滑油の粘度の増大とともに増加する傾向になる。この傾向は温度や圧力の変化に大きく左右されない。１０ＭＨｚより他の周波数を用いた場合は、図示していないが、超音波プローブより発信する超音波の周波数により潤滑油中の気泡に対する特性が異なる。５ＭＨｚ以上の高周波の超音波を用いると直径の小さな気泡まで敏感に検知でき、少量の気泡に対しても反射波の強度は大きく減少する。また、数百ｋＨｚないしそれ以下の低い周波数の超音波を用いると、反射波の強度の減少が小さくなり、多量の気泡を含む潤滑油の計測に適する。

【００３１】演算制御装置３０は、図１０に示すように、計測回路３１と演算回路３２と制御手段３３とから構成される。計測回路３１は周期的に各超音波プローブ１９を動作させ、超音波プローブ１９の出力から、超音波プローブ１９が発射した超音波が反射して戻ってきた強度及び反射時間を計測し、その値を演算回路３２に与える。演算回路３２は、冷凍空調用圧縮機内に設置された各超音波プローブについて、その超音波の伝搬距離に応じて図８に示すような冷媒混合の潤滑油中を伝播した超音波の強度と潤滑油中に含まれる気泡量との関係及び減衰率を予め記憶しており、圧縮機稼動中に周期的に各超音波プローブから与えられる超音波の強度から減衰率を算出し、この減衰率から油中の気泡量（％）に対応する値を出力するようにしている。また演算回路３２は、同様に各超音波プローブについて、図９に示すような冷媒混合の潤滑油中を伝播する超音波の音速と潤滑油の粘度との関係を予め記憶しており、圧縮機稼動中に周期的に各超音波プローブから与えられた超音波の音速に基づいて潤滑油粘度の値を出力するようにしている。

【００３２】制御手段３３は演算回路３２からの信号に基づき圧縮機の運転周波数を変化させ、電動機部３を制御する。一般的には、圧力負荷が過大な場合に潤滑不良が多く発生するため、回転周波数を下げて負荷を軽減するように制御する。

【００３３】冷凍サイクルが圧力負荷の検出機構を持ち、圧力負荷の過大が潤滑油不良の原因ではないと判断できる場合には、摺動速度を上げて被膜形成を上げることを目的として圧縮機回転周波数を上げる対応が適する場合もある。圧縮機の吐出圧力と吸入圧力の差が小さい場合には、必要量の給油が出来ないことが潤滑不良の原因と判断されることがあり、この場合には回転数を上げて圧力の差を大きくする。また、圧縮機構部２の運転を一時的に停止させて、潤滑不良の解消を図るようする場合もある。

【００３４】なお、各超音波プローブについて、演算装置への入力信号、演算内容及び演算装置からの出力信号を表示する表示手段を設けるとよい。これにより、圧縮機運転中の摺動部における冷媒混合潤滑油中の局所的な気泡量や粘度といった要素を連続的かつ定量的に判断でき、従来、長時間にわたる連続運転試験によって生じた摩耗状態によって確認されていた各摺動部の潤滑状態の把握を容易にすることが出来るため、冷凍空調圧縮機の信頼性の向上を実現することが出来る。

【００３５】

【発明の効果】本発明によれば、運転を継続したままで圧縮機内の摺動部における潤滑油の状態を、冷媒混合潤滑油中の気泡量や粘度といったパラメータにより定量的に把握して、潤滑油不良に応じて圧縮機を保護するように運転を制御できる冷凍空調圧縮機を実現することができる。

【図面の簡単な説明】

【図１】本発明の実施の形態１となるスクロール圧縮機の縦断面図である。

【図２】図１のＡ－Ａ線の断面図である。

【図３】図２のＢ－Ｂ線の断面図である。

【図４】摺動面に超音波プローブを露出させない検出部の構成図である。

【図５】背圧室及び油溜めにおける２つの超音波プローブを用いた検出部の構成図である。

【図６】背圧室及び油溜めにおける１つの超音波プローブと反射面を用いた検出部の構成図である。

【図７】本発明の実施の形態となるロータリー圧縮機を示す断面図である。

【図８】冷媒の混じる潤滑油中の気泡含有量と超音波減衰率との関係を示すグラフである。

【図９】冷媒の混じる潤滑油の粘度とその油中の超音波の音速との関係を示すグラフである。

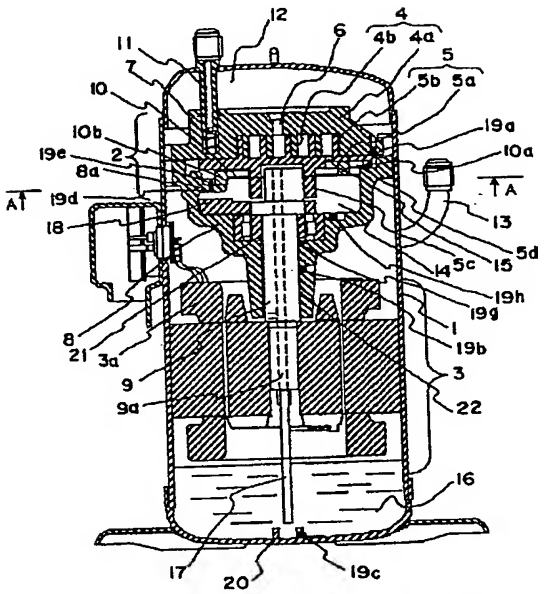
【図１０】圧縮機に設置した超音波プローブからの信号を処理する演算制御装置の構成を示す図である。

【符号の説明】

１　密閉容器
２　圧縮機構
３　電動機
４　固定スクロール
５　旋回スクロール
８　フレーム
８ａ　フレーム側キー溝
８ｂ　超音波プローブ保護壁
９　主軸

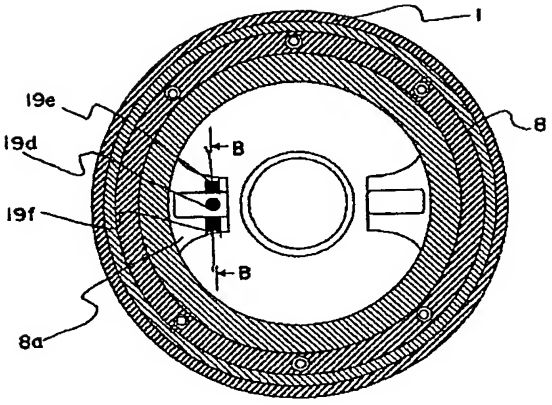
９ａ　給油孔
１０　オルダムリング
１０ｂ　オルダムリング側キー部
１６　潤滑油溜め
１９ａ～１９ｈ　超音波プローブ
２０　反射面
２１　スラスト軸受部材
２２　副軸受部材
３０　演算制御装置
３１　計測回路
３２　演算回路
３３　制御手段
４０　密閉容器
４１　主軸受部材
４２　回転シャフト
４３　圧縮室
４４　副軸受部材
４５　シリンダ
４６　ローラ
４７　電動機

【図１】

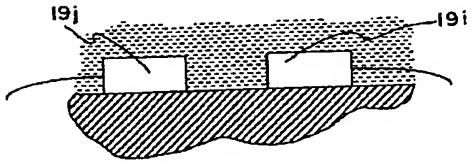


２：圧縮機構
３：電動機
４：固定スクロール
５：旋回スクロール
１０：オルダムリング
１６：潤滑油溜め
１９ａ～１９ｂ：超音波プローブ
２１：ころがり軸受

【図２】



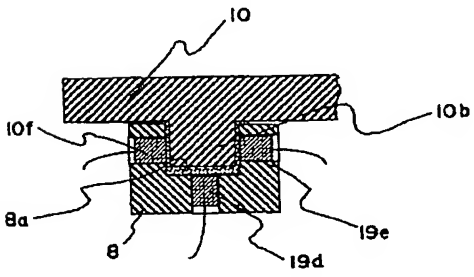
【図５】



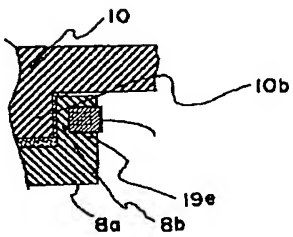
【図４】

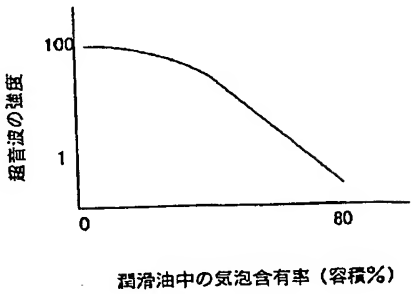
【図８】

【図３】

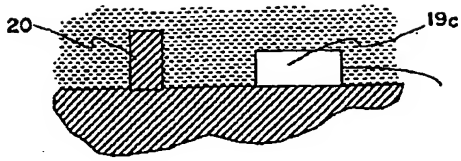


８ｂ：キー溝
１０ｂ：キー

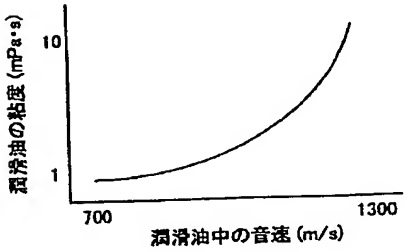




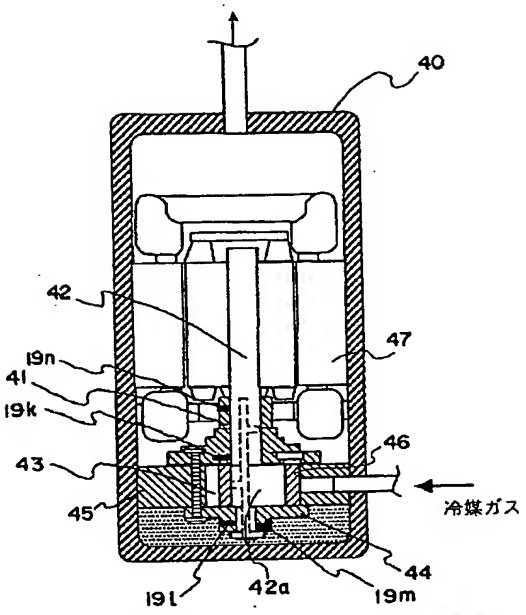
【図６】



【図９】

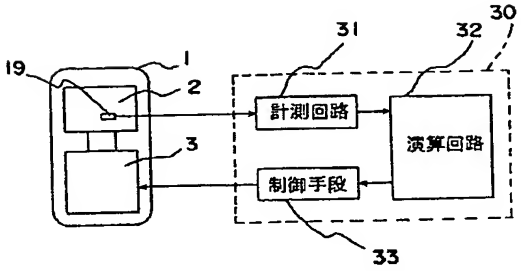


【図７】



１９ａ～１９ｂ：超音波プローブ
４１：主軸受部材
４３：圧縮室
４４：副軸受部材
４７：電動機
４２：回転軸
４２ａ：偏心軸部

【図１０】



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